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"You've modelled and now what?" - Exploring Determinants of Process Model Re-Use

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Abstract

Business process modelling as a practice and research field has received great attention over recent years. Organizations invest significantly into process modelling in terms of training, tools, capabilities and resources. The return on this investment is a function of process model re-use, which we define as the recurring use of process models to support organizational work tasks. While prior research has examined re-use as a design principle, we explore re-use as a behaviour, because evidence suggest that analysts' re-use of process models is indeed limited. In this paper we develop a two-stage conceptualization of the key object-, behaviour- and socio-organization-centric factors explaining process model re-use behaviour. We propose a theoretical model and detail implications for its operationalization and measurement. Our study can provide significant benefits to our understanding of process modelling and process model use as key practices in analysis and design.

Keywords: Process modelling, model re-use, theory development, value of process modelling

INTRODUCTION

Process models provide information about tasks, data, resources, actors and their relationships in processes (Curtis, Kellner and Over 1992) and describe business requirements for (re-)designing organizational or technological systems to support them (Kock et al. 2009). Many organizations commit ongoing and substantial investments in process modelling and the creation of process model collections (Raduescu et al. 2006). Wolf and Harmon (2008) estimated that investments in process modelling range from USD 500,000 to over USD 10 million.

A major challenge that organizations face after having invested in process modelling is that models fall into disuse after their creation, leading to the conclusion that the initial investment may be lost or of little value (Wand and Weber 2002). Thus process model re-use has been coined one of the top ten challenges of process modelling (Indulska et al. 2009b). This is because a key benefit of it resides in the ability to improve organizational communication, analysis and re-design efforts (Kock et al. 2009), which are benefits that manifest only if and when models are used – and re-used for multiple purpose and initiatives (Rosemann 2006).

We aim at exploring determinants of individuals´ process model re-use behaviour. Knowledge about factors driving re-use will aid organizations in their modelling endeavours and can positively influence them. We define process model re-use as the post-creation usage of process models, thus using them for a different *purpose*, by a different *user*, or at a different *point in time*. Re-use in this context is different to continued use (Burton-Jones and Straub 2006) as it includes using a model beyond its original context in terms of person, task or time but without requiring continued use. Emphasizing re-use beyond a model's original purpose, creator and/or use also delineates our study from related work on re-use for process model design (e.g., Mendling, Strembeck and Recker 2012) or designing process models for re-use (e.g., La Rosa et al. 2011a). Our research question is: *What factors lead to re-use of existing process models?*

This paper unfolds as follows. First we review related work on process modelling and our understanding of (re-) use as a behaviour. Then we report on our conceptual model to explain process model re-use behaviour followed by describing a possible operationalization of its parameters, before discussing implications and shortcomings.

RELATED WORK

Process Models and Process Modelling in Practice

Process models are created for a certain purpose (Curtis, Kellner and Over 1992), such as documenting an organization's processes (van der Aalst et al. 2003), informing software development (Ouyang et al. 2009) or to support communication thus becoming tools for organizational redesign and planning (Kock et al. 2009). After their creation, process models are typically stored in repositories (La Rosa et al. 2011b) and made available to end users through intranet platforms, tools, in presentation software or as physical artefacts.

Process model use has been examined in the literature primarily from two angles: it has been examined how process model use can be supported and enhanced, e.g., through advanced repositories (La Rosa et al. 2011b) or through providing different user interfaces, like virtual reality systems (Brown, Recker and West 2011) or touch interfaces (Fleischmann and Stary 2011). A second stream of research has examined practices related to process modelling, e.g., modelling grammar (Recker et al. 2010) or tool usage (Recker 2012). Use of process models, however, has almost exclusively been studied from the perspective of whether users understand process models (e.g., Reijers and Mendling 2011; Bera 2012), but not why and how they use them to support work tasks.

We are interested in who re-uses a process model after it has been created, to what end, how often and why. Organizations intent to (re-) use process models for various activities from documentation to re-design and knowledge management (Recker et al. 2010). Whether and to what extent this planned re-use actually manifest in individual re-use of process models is largely unknown. Commentaries (Rosemann 2006) and studies (Indulska et al. 2009b) suggest that re-use is not often achieved in practice, thus diminishing return on investments into modelling and limiting its value for an organization. Studies have shown that process model use can lead to several benefits (Indulska et al. 2009a) such as effective stakeholder communication, development of domain understanding or re-design project success. Such benefits can only be generated if process models are being (re-) used in tasks that aim at creating these benefits – staff induction, process re-design, simulation and learning are just a few of them.

Re-use as a Behaviour

To guide the development of substantive theory on process model re-use, we examined studies of re-use as a behaviour in other fields of research. To assist our exploration of the literature, we followed existing guidelines for literature search and review (Webster and Watson 2002). Specifically, we started by searching for the term *model re-use* and then added related terms such as *code re-use* and *database query re-use*. We did not limit our search to IS related publications only but deliberately included publications from other fields in order to identify theorizing efforts around re-use behaviour from which we may learn about relevant conditions and mechanisms. This search strategy was important because model re-use as a behaviour is essentially an information seeking behaviour (Wilson 2000) that is not dissimilar to seeking for knowledge to reuse or for product information when seeking to repurchase. Table 1 provides a summary of our exploration of re-use as a behaviour in literature. We note that the discussion of the literature in Table 1 is illustrative rather than comprehensive; a more detailed summary of the relevant literature was omitted due to page limitations, but will be added to the full paper.

We identify four key implications from our literature review.

- Re-use is dependent on the quality of the artefact as well as users' perceptions of it suggesting that process model re-use will vary dependent on users' perceptions of its attributes (e.g. its semantic quality).
- Individual factors such as task motivation and familiarity with the artefact as well as the domain it is used in play a decisive role in peoples' intention to re-use that artefact.
- Organizational factors such as influence by superiors or norms can promote or hinder re-use.
- The IT infrastructure has an impact on re-use as it provides access to the models from an interaction as well as an access perspective.

We extend the existing body of literature in several ways. First, we examine re-use in the *context* of process modelling. Furthermore we explore re-use from a *behavioural perspective,* which only has been done in studies of open source code re-use and repurchase intentions so far (Hars and Ou 2002; Chiu et al. 2009). In most other studies, the focus has been on supporting the re-use process, e.g. through incentives or strategies (e.g., Morisio, Ezran and Tully 2002), or re-use activities have been examined rather than the factors that determine them (Allen and Parsons 2010). We also found *inconsistencies* considering the influence of some re-use determinants such as trust or system quality. For example, Chiu et al. (2009) found the perceived quality of a website to influence a users' intention to repurchase a product there while Loiacono et al. (2007) did not find the perceived quality of a website to impact a users' intention to revisit it. Watson and Hewett (2006) found trust in an information source to impact a persons' intention to re-use that information while Loiacono et al. (2007) did not find any impact of trust on a users' intention to revisit a website. Thus another planned contribution of our study will be to explore and resolve these inconsistencies with respect to the re-use of an information artefact (a process model).

Table 1: Selected Related Work about Re-use as a Behaviour.

Context	Relevant Literature	Key Findings	Implications for Understanding Process Model Re-Use
Knowledge re-use	Watson and Hewett (2006)	Re-use is dependent on ease of access, incentives, support by intermediaries, and users' trust in the information source and domain familiarity.	Facilitating conditions and support determine individual re-use intentions.
Corporate code re-use	Leveson and Turner (1993); Frakes and Fox (1995); Morisio et al. (2002)	Re-use is dependent on code quality as well as training, monetary incentives and re-use processes within the organization.	Model quality and the organizational re-use processes influence re-use.
Open source code re-use	Hars and Ou (2002); Haefliger et al. (2008)	Re-use is dependent on personal factors: intrinsic and extrinsic motivation, altruism, and personal need for a software solution. Re-use can reduce development time and costs.	Motivational and resource-related drivers are key to understanding re-use of a model.
Database query re-use	Allen and Parsons (2010)	Successful re-use is dependent on domain familiarity and opportunity to re-use.	Users consciously explore opportunities for re-use in different task settings.
Repurchase intention	Chiu et al. (2009); Hellier et al. (2003); Loiacono et al. (2007)	Repurchase intention is dependent on previous satisfaction with, timeliness of information about, and usefulness of an object. The role of trust in an object and the object's quality is ambiguous.	Characteristics and information about a model and peoples' attitude towards it may influence re-use.

A TWO-STAGE MODEL OF PROCESS MODEL RE-USE

To develop an understanding of the factors that determine the variance in an individual's re-use of a process model, we developed a substantive conceptual framework that draws attention to relevant categories of concepts and positions them in a nomological net.

Figure 1 shows our view of that model, which is structured around four main categories of factors identified from the literature in a two-stage model from current use to re-use. The central thesis of our model is that variance in an individual's intention to re-use a process model is dependent on (a) factors describing properties of the process model considered for re-use, and (b) characteristics of the individual process model user. These relationships are being moderated by (c) organizational factors that determine the extent of social and normative pressure on re-use behaviour, and (d) attributes of information systems that provide access to a model.

Process model re-use in our framework is defined as the extent to which a process model is employed again by an individual user to perform a task. Important to this definition is the connotation of a *repeat* usage at a *different point in time*, or for a *different task*. Our definition also highlights re-use as an information seeking behaviour (Wilson 2000) that is employed within a work task, rather than a modelling-related task itself (e.g., the revision or extension of the process model itself). Understanding re-use as a behaviour is important, because models yield knowledge about the process that can be relevant to a variety of task settings (Rosemann 2006).

To clarify the boundaries of our process model re-use definition, Table 2 summarizes the differences of re-use to related concepts such as initial process model use, continued use, and use for revising the process model itself.

We characterize process model re-use alongside three dimensions, similar to (Burton-Jones and Straub 2006): *intensity* of use (number of times a model is being used in a given time period), *duration* of use (average time of using a model), and *variety* of use (number of tasks a model is used for). With these three dimensions, we can distinguish multiple forms of reuse such as revisiting a model for the same task at a later point in time (e.g. one week later), using a model for a different task (e.g. for organizational analysis or improvement) or immersing oneself more deeply into the content of a model (studying it again for several minutes after taking a glance).

Table 2: Re-Use Compared to other Forms of Interaction with Process Models.

	Purpose	User	Point in Time	Frequency
(initial) Use	Creation of the model as an artefact (e.g. to document a work process).	Creator	t = 1	Once
Revision	Revision or extension of the content of a process model.	(Co-) creator	t = 2 to n	On demand
Continued use	The sustained use of a process model in support of one particular work task (e.g., continued use in a process improvement project).	Model end user	t = 2 to n	Regularly
Re-use	*Repeated use of a model for original or novel use for different purpose across multiple work tasks (e.g., in multiple projects)*	*Model end user*	*t = 2 to n*	*On demand*

Further, we conceptualize process model re-use behaviour as a direct consequence of the intention to re-use process models determined by beliefs in a current usage stage. That is, our model suggests that current beliefs about the model as an object and the task setting in which the user operates, influenced by beliefs about technology support for using the model will determine current intentions to re-use a model which can translate into actual re-use behaviour. The translation of intentions to behaviours will be moderated by the *perceived voluntariness* of that behaviour. Perceived voluntariness (Moore and Benbasat 1991) defines the degree to which re-use of a process model is perceived as being of free will versus mandated by superiors or other individuals. Perceived voluntariness can affect the determination of behaviours from intentions in that lowered perceived voluntariness typically diminishes the translation of intentions to actual behaviours (Venkatesh et al. 2003). In process modelling projects, it is important to consider the perceived voluntariness of process model use because often, process model use is governed or mandated by organizational policies or project conventions (Recker et al. 2010). These policies influence perceived voluntariness as it is unlikely that people will perceive re-use to be voluntary when it is demanded by project conventions. In turn also the lack of such demands will become visible when measuring perceived voluntariness as a behaviour that is not demanded by an organization will certainly perceived to be voluntary.

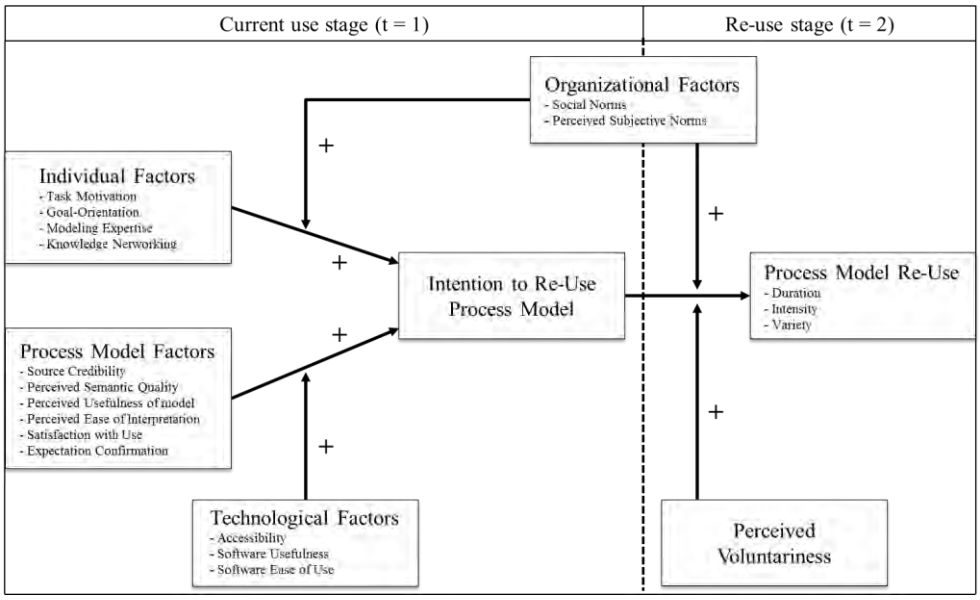

Figure 1: A Two-Stage Model of Process Model Re-Use.

Process Model Factors

Process model factors describe artefact properties that are expected to have an immediate impact on an individual's intention to re-use a process model. As process models essentially are informational artefacts, their accuracy and the relevance of the information contained in them are important to users, which can be expressed as the *perceived semantic quality* of a model (Maes and Poels 2007). Next, process models in essence describe knowledge encoded in the process model by the model creator. Thus, re-use of a model as an informational object will vary depending on the *ease of interpretation* of that model (Gemino and Wand 2005). Also the use of

the knowledge expressed in the model will vary depending on the *credibility of the knowledge source* – the model creator (Ko, Kirsch and King 2005). Finally, post-creation use of models will also vary depending on perceptions of *usefulness*, *satisfaction* with use and users *confirmation of pre-usage expectations* (Bhattacherjee 2001).

Individual Factors

Individual factors such as motivation and previous experience play a vital role in understanding a person´s intention to use and subsequently use an object (Bhattacherjee 2001). An individual's intention to re-use a process model, therefore, will be dependent on the *motivation* a user has towards performing the task for which the model can be used. Other drivers of behaviour are *goals* of a person, e.g. the desire to increase their knowledge or performance. This is important as process models represent real life processes thus studying them yields knowledge about the process they depict (Recker and Dreiling 2011). Acquiring additional knowledge about a process may potentially be beneficial for an individual's performance. However, as extracting knowledge about a process from a model depends on a person's ability to understand it, *modelling expertise* is also important as this is expected to be easier for people who are skilled in using process models (Reijers and Mendling 2011). But even if an individual does not understand a model on her/his own, s/he might be supported in doing so by a knowledgeable person. Thus, knowing people who know about the model or process also might be important for a person's intention to re-use a process model. While this factor – which is subsumed as *knowledge networking* (Bassellier and Benbasat 2004) – might not be important for a person with a stable re-use intention, it is still very likely that it has an influence on re-use behaviour as it might be hard for a person without knowledge about models and modelling to convey the information that is encoded within a process model and use it for work tasks.

Technological Factors

Process models are usually created, viewed and presented using a modelling tool and stored electronically (e.g., a knowledge management system or a BPM suite, Recker 2012). While they can be accessed and used without technology, we expect technology support to increase the likelihood of process model re-use if the process model is easy to access using technology (Wixom and Todd 2005). This is because *accessibility* of process models describes the effort of finding a model and having access to the right tools to work with it. Also, past research has firmly established that technology use and individual task performance from technology use are rooted in perceptions of *usefulness* and *ease of use* (Davis 1989), which we thus expect to moderate individuals' re-use of models as informational artefacts provided through the modelling software. The effect of this moderation is expected to be a steeper decline in an individual's intention to re-use a process model when access to it is very hard while the benefit of easy access, conversely, may lead to increased willingness to re-use process models.

Organizational Factors

Model re-use happens within a work environment (Wand and Weber 2002). Two factors specifically are relevant to understanding how *organizational factors* such as policies and social norms (Cialdini and Goldstein 2004) that explicitly and implicitly govern the behaviour of actors within an organization will impact both re-use intentions (in the current usage stage) as well as the translation of these to behaviours (during the re-use stage). First we posit that *perceived subjective norms* (Mathieson 1991) can moderate the strength of the relationship between individual factors and the formation of re-use intentions. For example, if a superior or a role model is known to use process models, it is likely that individuals that perceive these persons as influential will follow this behaviour (Ajzen 1991). Furthermore *social norms* (Thompson, Higgins and Howell 1991) may exist that are not covered by an organization's policies but still influence people´s behaviour. These norms may result in either more or less occurrences of process model re-use. For example, if process model re-use is a common activity, an individual likely will also pick up on process model re-use based upon this perception (Cialdini and Goldstein 2004).

RESEARCH DESIGN AND MEASUREMENT

Various options exist to examine re-use as a behaviour. For example, qualitative inquiries based on case studies can shed light into socio-organizational and contextual factors that relate to process model re-use by individuals or even teams. They can also be used to examine the internal and conclusion validity of an emerging theoretical model such as ours. On the other hand, the literature suggests that specifically longitudinal methods are suitable for studying re-use intentions and behaviour (Pettigrew 1995). They allow for examining the processes through which re-use occurs as well as the evolution of re-use behaviour over time.

The two-stage conceptualization of our model requires a longitudinal data collection strategy. The use of operationalized constructs with validated measurements further suits a quantitative data collection strategy. Therefore, we plan to capture and explain variance in re-use behaviours through a two time-period cross-sectional survey. A cross-sectional survey will allow us to explore re-use across large samples of individuals, work task settings and types of process models (Newsted, Huff and Munro 1998) and in turn increase the robustness and generalizabil-

ity of the findings by gathering data from respondents across regions, cultures and contexts. This approach also is especially suitable for research that focuses on behaviours (Malhotra and Grover 1998).

The population of interest to our study are analysts working with process models as part of their work tasks. We do not impose restrictions of model use tasks but instead seek to capture the variety of tasks for which models are employed. We do, however, rule out any tasks that involve creating new process models, model parts or refining existing models. Furthermore we only include individuals with previous experience with models as they are difficult to re-use without any knowledge about modelling or modelling grammars.

It will be important for validating our model to capture data at two points in time: (a) perceptions and behaviours about the current use of a process model and beliefs about re-use intentions, and (b) measuring actual re-use of that model at a later point in time (e.g. one month later). It is also important to capture current perceptions and re-use data in relation to one specific process model. We will thus provide an opportunity for respondents to select a process model they have (most recently) worked with, and to describe this model. All measurement items will peruse this model as the behavioural target (Ajzen 1991) in which all questions are anchored.

Where possible, we will draw construct operationalizations from established measures. Table 3 summarizes key construct definitions of our model as well as sample measures which we adapted for inclusion in the context described here while paying specific attention to differentiate the measures for each factor included in our research model (e.g. perceived usefulness of a process model vs. perceived usefulness of a modelling software).

Table 3: Key Construct Definitions and Illustrative Measurements.

Category	Construct	Study Definition	Sample Measures (7-point Likert scales)
Individual Factors	Task motivation (Hars and Ou 2002)	Using a process model for no apparent reinforcement other than the task of using it, e.g. to gain knowledge about a process.	Using this process model gives me a feeling of effectiveness.
	Goal-orientation (Button, Mathieu and Zajac 1996)	Performance goals characterize individuals who seek to gain favourable judgments of their competence about a process or avoid negative evaluations of such by using a process model.	I prefer to do things that I can do well rather than things that I do poorly.
		Learning goals characterize individuals who seek to increase their competence, to understand or master a process by using a process model.	I prefer to work on tasks that force me to learn new things.
	Modelling expertise (Reijers and Mendling 2011)	The degree to which an individual is informed and an expert on the matter of process modelling.	If two activities are concurrent, then they are executed at the same time in a process model. (*true / false*)
	Knowledge networking (Bassellier and Benbasat 2004)	An individual's competence to know where knowledge about effective process model use resides within and outside an organization.	If I have a question or problem related to using this process model that I cannot solve alone, I am confident that I find the right person to contact in my organization.
Process Model Factors	Source credibility (Ko, Kirsch and King 2005)	The extent to which a process model user perceives the model creator to be trustworthy and an expert.	The creator of the process model is trustworthy.
	Perceived semantic quality (Maes and Poels 2007)	The degree of correspondence between the information conveyed by a process model and the domain that is modelled.	The process model represents the process correctly.
	Perceived usefulness of model (Davis 1989)	The degree to which a person believes (re-) using a particular process model will be effective in achieving an intended goal.	I found using this process model useful for the task I set out to do.
	Perceived ease of interpretation (Davis 1989)	The degree to which a person believes that interpreting a process model would be free of effort.	Overall, this process model was easy to use.

	Satisfaction with model use (Bhattacherjee and Premkumar 2004)	The level of approval when a person compares her/his expected performance when using process models with the actual performance.	I am ... with my use of this process model. (*extremely dissatisfied* to *extremely satisfied*)
	Expectation confirmation (Bhattacherjee and Premkumar 2004)	The degree to which initial expectations towards process model use were met through usage.	Compared to my initial expectations about the use of this process model, its ability to be useful for my work was: (*much worse than expected* to *much better than expected*)
Technological Factors	Accessibility (Wixom and Todd 2005)	The ease with which a process model can be accessed or extracted from a modelling software.	The process model is easy to access.
	Software usefulness (Davis 1989)	The degree to which a person believes that using a modelling software will be effective in (re-) using a process model.	I find the modelling software useful for reading this process model and obtaining information from it.
	Software ease of use (Davis 1989)	The degree to which a person believes that using a modelling software for (re-) using a process model would be free of effort.	I find the modelling software easy to use.
Organizational Factors	Social norms (Cialdini and Goldstein 2004)	What people in a process model user group believe to be a typical action, an appropriate action or both.	People who are important to me within my organization think that I should use process models.
	Perceived subjective norms (Mathieson 1991)	The perceived opinions of a person or group whose beliefs may be important to the individual about process model re-use.	Those people who are important to me within my organization would support me in using this process model.
Intention to Re-Use Process Model	Behavioural intention (Davis 1989)	The strength of one's intention to (re-) use a process model.	I intend to re-use this process model to support my work task.
Perceived Voluntariness	Perceived Voluntariness (Agarwal and Prasad 1997)	The extent to which a person perceives re-using process models to be non-mandatory.	My superiors expect me to use process models.
Process Model Re-Use	Intention to re-use model (Bhattacherjee 2001)	The strength of one's intention to re-use a process model.	I intend to re-use this process model to support my work task.
	Duration (Mendling, Strembeck and Recker 2012)	The average time an individual spent re-using a process model in a particular time period.	
	Intensity (Mendling, Strembeck and Recker 2012)	The number of times an individual re-used a model since its creation in a particular time period.	
	Variety (Burton-Jones and Straub 2006)	The number of different tasks a model has been re-used for in a particular time period.	

INTERIM CONCLUSIONS

We believe our work can have significant implications for our understanding of process modelling as a key practice in organizational change or system design projects. This study develops the first conceptualization and proposes a quantitative empirical study of process model re-use in organizational practice. Understanding the determinants of re-use will increase our understanding of how organizations can maximize value from process model

re-use and thus increase the success of analysis and design projects in general. This is because knowledge about re-use behaviours will ultimately yield new insights into how to potentially increase process model usage after their creation. Finally this model will be a starting point for understanding process model usage over time rather than focusing on single events where models are used. This not only adds to our understanding of process model usage but might also provide insights into re-use of information artefacts in an organizational context in general thus being relevant to other fields such as software development and knowledge management.

Using a survey method to test our research model also has some limitations. Even though we will use the survey repeatedly, each survey will only examine a certain point in time rather than giving insights into the development of behaviour over time. Furthermore we rely on self-reported views of the participants. To mitigate these limitations we will try to gather factual data about process models and their use from repository access statistics. We also note the inherent weaknesses of survey methods in developing novel theory when compared to interpretive, qualitative approaches. However, our research model builds on established theories and validated operationalizations, in turn increasing confidence in its validity and reliability, and the survey method will allow us not only to propose novel theory but also to present a stronger test of the theory than qualitative inquiry could.

At the time of presentation, the conceptualization (conceptual definitions of new constructs or redefinitions of existing constructs), measure development (generation of measurement items to represent the constructs), and formal specification of the measurement model phase (expected indicator-construct relationships and the measurement item scale definition) are completed and we are finalizing a pilot test of the measurement instrument with process model users from the higher education sector. We will discuss the pilot test results during the presentation. We will then gather data globally from process model users through a web-based survey.

REFERENCES

Agarwal, R & Prasad, J 1997, 'The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies', *Decision Sciences,* vol. 28, no. 3, pp. 557-582.

Ajzen, I 1991, 'The Theory of Planned Behaviour', *Organizational Behavior and Human Decision Processes,* vol. 50, no. 2, pp. 179-211.

Allen, G & Parsons, J 2010, 'Is Query Reuse Potentially Harmful? Anchoring and Adjustment in Adapting Existing Database Queries', *Information Systems Research,* vol. 21, no. 1, pp. 56-77.

Bassellier, G & Benbasat, I 2004, 'Business Competence of Information Technology Professionals: Conceptual Development and Influence on IT-Business Partnerships ', *MIS Quarterly,* vol. 28, no. 4, pp. 673-694.

Bera, P 2012, 'Does Cognitive Overload Matter in Understanding BPMN Models?', *Journal of Computer Information Systems,* vol. 52, no. 4, pp. 59-69.

Bhattacherjee, A 2001, 'Understanding Information Systems Continuance: An Expectation-Confirmation Model', *MIS Quarterly,* vol. 25, no. 3, pp. 351-370.

Bhattacherjee, A & Premkumar, G 2004, 'Understanding Changes in Belief and Attitude Toward Information Technology Usage: A Theoretical Model and Longitudinal Test', *MIS Quarterly,* vol. 28, no. 2, pp. 229-254.

Brown, R, Recker, J & West, S 2011, 'Using Virtual Worlds for Collaborative Business Process Modeling', *Business Process Management Journal,* vol. 17, no. 3, pp. 546-564.

Burton-Jones, A & Straub, DW 2006, 'Reconceptualizing System Usage: An Approach and Empirical Test', *Information Systems Research,* vol. 17, no. 3, pp. 228-246.

Button, SB, Mathieu, JE & Zajac, DM 1996, 'Goal Orientation in Organizational Research: A Conceptual and Empirical Foundation', *Organizational Behavior and Human Decision Processes,* vol. 67, no. 1, pp. 26-48.

Chiu, C-M, Chang, C-C, Cheng, H-L & Fang, Y-H 2009, 'Determinants of Customer Repurchase Intention in Online Shopping', *Online Information Review,* vol. 33, no. 4, pp. 761-784.

Cialdini, RB & Goldstein, NJ 2004, 'Social Influence: Compliance and Conformity', *Annual Review of Psychology,* vol. 55, pp. 591-621.

Curtis, B, Kellner, MI & Over, J 1992, 'Process Modeling', *Communications of the ACM,* vol. 35, no. 9, pp. 75-90.

Davis, FD 1989, 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quarterly,* vol. 13, no. 3, pp. 319-340.

Fleischmann, A & Stary, C 2011, 'Key Features of Subject-Oriented Modeling and Organizational Deployment Tools' in Stephanidis, C (ed.) *Universal Access in Human-Computer Interaction - HCI 2011*, Springer, Orlando, Florida, pp. 205-214.

Frakes, WB & Fox, CJ 1995, 'Sixteen Questions About Software Reuse', *Communications of the ACM,* vol. 38, no. 6, pp. 75-87.

Gemino, A & Wand, Y 2005, 'Complexity and Clarity in Conceptual Modeling: Comparison of Mandatory and Optional Properties', *Data & Knowledge Engineering,* vol. 55, no. 3, pp. 301-326.

Haefliger, S, von Krogh, G & Spaeth, S 2008, 'Code Reuse in Open Source Software', *Management Science,* vol. 54, no. 1, pp. 180-193.

Hars, A & Ou, S 2002, 'Working for Free? Motivations for Participating in Open-Source Projects', *International Journal of Electronic Commerce,* vol. 6, no. 3, pp. 25-39.

Hellier, PK, Geursen, GM, Carr, RA & Rickard, JA 2003, 'Customer Repurchase Intention: A General Structural Equation Model', *European Journal of Marketing,* vol. 37, no. 11-12, pp. 1762-1800.

Indulska, M, Green, P, Recker, J & Rosemann, M 2009a, 'Business Process Modeling: Perceived Benefits' in Castano, S, Dayal, U & Laender, AHF (eds.) *Conceptual Modeling - ER 2009*, Springer, Gramado, Brazil, pp. 458-471.

Indulska, M, Recker, J, Rosemann, M & Green, P 2009b, 'Process Modeling: Current Issues and Future Challenges' in van Eck, P, Gordijn, J & Wieringa, R (eds.) *Advanced Information Systems Engineering - CAiSE 2009*, Springer, Amsterdam, The Netherlands, pp. 501-514.

Ko, D-G, Kirsch, LJ & King, WR 2005, 'Antecedents of Knowledge Transfer from Consultants to Clients in Enterprise Systems Implementations', *MIS Quarterly,* vol. 29, no. 1, pp. 59-85.

Kock, N, Verville, J, Danesh-Pajou, A & DeLuca, D 2009, 'Communication Flow Orientation in Business Process Modeling and Its Effect on Redesign Success: Results from a Field Study', *Decision Support Systems,* vol. 46, no. 2, pp. 562-575.

La Rosa, M, Dumas, M, ter Hofstede, AHM & Mendling, J 2011a, 'Configurable Multi-Perspective Business Process Models', *Information Systems,* vol. 36, no. 2, pp. 313-340.

La Rosa, M, Reijers, HA, van der Aalst, WMP, Dijkman, RM, Mendling, J, Dumas, M & Garcia-Banuelos, L 2011b, 'APROMORE: An Advanced Process Model Repository', *Expert Systems with Applications,* vol. 38, no. 6, pp. 7029-7040.

Leveson, NG & Turner, CS 1993, 'An Investigation of the Therac-25 Accidents ', *Computer,* vol. 26, no. 7, pp. 18-41.

Loiacono, ET, Watson, RT & Goodhue, DL 2007, 'WebQual: An Instrument for Consumer Evaluation of Web Sites', *International Journal of Electronic Commerce,* vol. 11, no. 3, pp. 51-87.

Maes, A & Poels, G 2007, 'Evaluating Quality of Conceptual Modelling Scripts Based on User Perceptions', *Data & Knowledge Engineering,* vol. 63, no. 3, pp. 769-792.

Malhotra, MK & Grover, V 1998, 'An Assessment of Survey Research in POM: From Constructs to Theory', *Journal of Operations Management,* vol. 16, no. 4, pp. 407-425.

Mathieson, K 1991, 'Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior', *Information Systems Research,* vol. 2, no. 3, pp. 173-191.

Mendling, J, Strembeck, M & Recker, J 2012, 'Factors of Process Model Comprehension — Findings from a Series of Experiments', *Decision Support Systems,* vol. 53, no. 1, pp. 195-206.

Moore, GC & Benbasat, I 1991, 'Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation', *Information Systems Research,* vol. 2, no. 3, pp. 192-222.

Morisio, M, Ezran, M & Tully, CJ 2002, 'Success and Failure Factors in Software Reuse', *IEEE Transactions on Software Engineering,* vol. 28, no. 4, pp. 340-357.

Newsted, PR, Huff, SL & Munro, M 1998, 'Survey Instruments in Information Systems', *MIS Quarterly,* vol. 22, no. 4, pp. 553-554.

Ouyang, C, van der Aalst, WMP, Dumas, M, ter Hofstede, AHM & Mendling, J 2009, 'From Business Process Models to Process-Oriented Software Systems', *ACM Transactions on Software Engineering Methodology,* vol. 19, no. 1, pp. 2-37.

Pettigrew, AM 1995, 'Longitudinal Field Research on Change: Theory and Practice' in Huber, GP & Van de Ven, AH (eds.) *Longitudinal Field Research Methods: Studying Processes of Organizational Change*, Sage, Thousand Oaks, California, pp. 91-125.

Raduescu, C, Tan, HM, Jayaganesh, M, Bandara, W, zur Muehlen, M & Lippe, S 2006, 'A Framework of Issues in Large Process Modeling Projects', paper presented to the 14th European Conference on Information Systems, Goeteborg, Sweden.

Recker, J 2012, '"Modeling with Tools is Easier, Believe Me" - The Effects of Tool Functionality on Modeling Grammar Usage Beliefs', *Information Systems,* vol. 37, no. 2, pp. 213-226.

Recker, J & Dreiling, A 2011, 'The Effects of Content Presentation Format and User Characteristics on Novice Developers' Understanding of Process Models', *Communications of the Association for Information Systems,* vol. 28, no. 6, pp. 65-84.

Recker, J, Indulska, M, Rosemann, M & Green, P 2010, 'The Ontological Deficiencies of Process Modeling in Practice', *European Journal of Information Systems,* vol. 19, no. 5, pp. 501-525.

Reijers, HA & Mendling, J 2011, 'A Study into the Factors that Influence the Understandability of Business Process Models', *IEEE Transactions on Systems Man & Cybernetics, Part A,* vol. 41, no. 3, pp. 449-462.

Rosemann, M 2006, 'Potential Pitfalls of Process Modeling: Part A', *Business Process Management Journal,* vol. 12, no. 2, pp. 249-254.

Thompson, RL, Higgins, CA & Howell, JM 1991, 'Personal Computing: Towards a Conceptual Model of Utilization', *MIS Quarterly,* vol. 15, no. 1, pp. 125-143.

van der Aalst, WMP, ter Hofstede, AHM, Kiepuszewski, B & Barros, AP 2003, 'Workflow Patterns', *Distributed and Parallel Databases,* vol. 14, no. 1, pp. 5-51.

Venkatesh, V, Morris, MG, Davis, GB & Davis, FD 2003, 'User Acceptance of Information Technology: Toward a Unified View', *MIS Quarterly,* vol. 27, no. 3, pp. 425-478.

Wand, Y & Weber, R 2002, 'Research Commentary: Information Systems and Conceptual Modeling - A Research Agenda', *Information Systems Research,* vol. 13, no. 4, pp. 363-376.

Watson, S & Hewett, K 2006, 'A Multi-Theoretical Model of Knowledge Transfer in Organizations: Determinants of Knowledge Contribution and Knowledge Reuse', *Journal of Management Studies,* vol. 43, no. 2, pp. 141-173.

Webster, J & Watson, RT 2002, 'Analyzing the Past to Prepare for the Future: Writing a Literature Review', *MIS Quarterly,* vol. 26, no. 2, pp. xiii-xxiii.

Wilson, TD 2000, 'Human Information Behaviour', *Informing Science,* vol. 3, no. 2, pp. 49-55.

Wixom, BH & Todd, PA 2005, 'A Theoretical Integration of User Satisfaction and Technology Acceptance', *Information Systems Research,* vol. 16, no. 1, pp. 85-102.

Wolf, C & Harmon, P 2008, *The State of Business Process Management - 2008,* www.BPTrends.com.

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